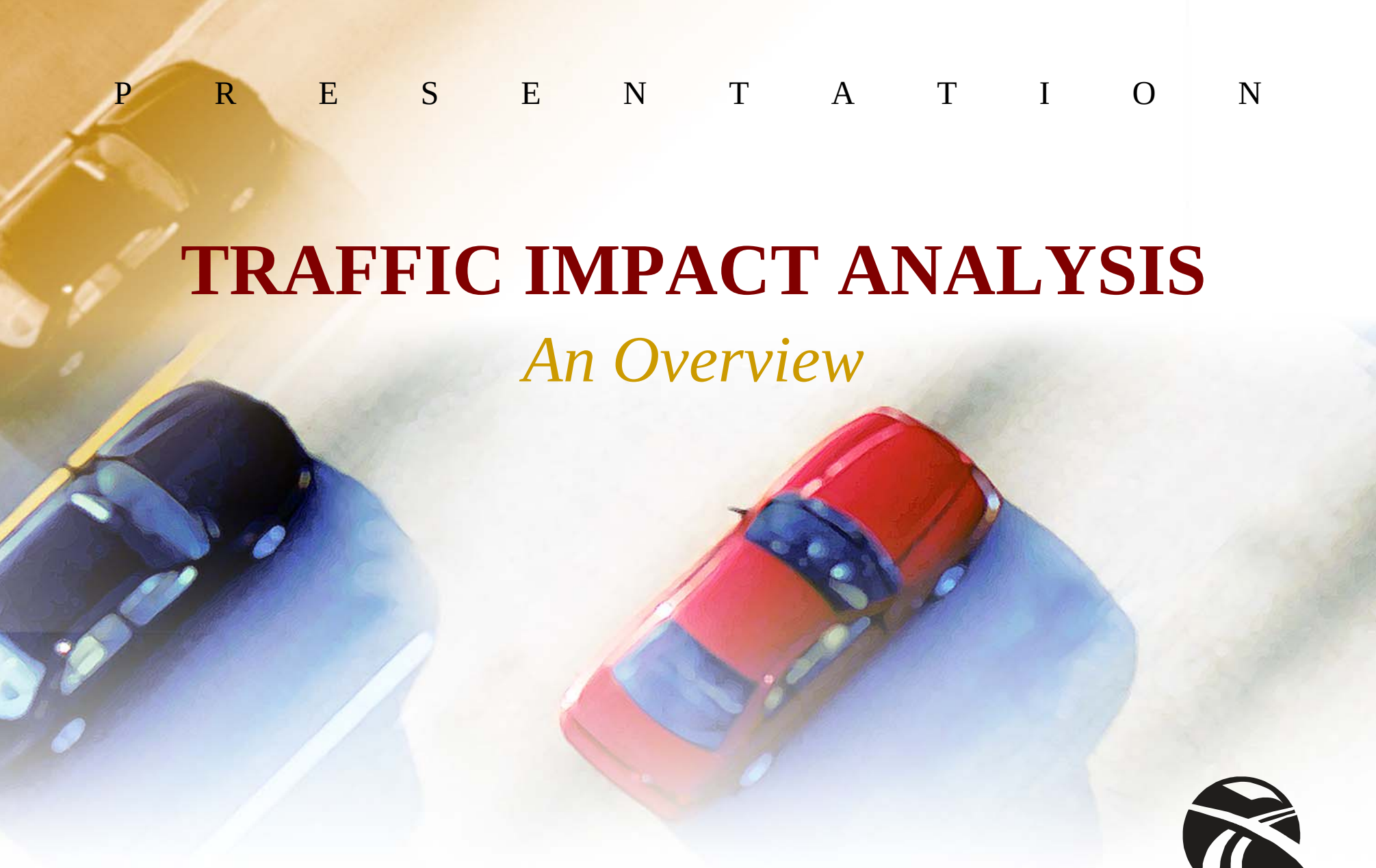
P R E S E N T A T I O N

TRAFFIC IMPACT ANALYSIS

An Overview



Presented by: Reza Karimvand, P.E.
Baja Regional Traffic Engineer
Arizona Department of Transportation

Agenda

- Definition
- Major Elements of TIA
- Study Parameters
- Process Overview
- Data Collection
- Analysis Requirements
- Mitigation Thresholds
- Reference Materials
- Example

Definition

A Traffic Impact Analysis is a traffic engineering study which determines the potential traffic impacts of a proposed development.

Major Elements

A complete analysis includes:

- Existing Conditions Analysis
- Estimation of Future Traffic without Development
- Estimation of Future Traffic with Development
- Analysis of Traffic Impacts
- Recommended Roadway Improvements

Study Parameters

- Study Area - Ranges from adjacent intersections only to all major intersections within 1 mile
- Horizon Years - Ranges from opening year only to 15 years after opening
- Both parameters are based on development type and size

Study Parameters *(cont'd)*

ADOT REQUIREMENTS

Analysis Category	Development Characteristics (d)	Study Horizons (a)	Minimum Study Area on the State Highway(s) (c)
I	Small Development <500 peak hour trips	1. Opening year	1. Site access driveways 2. Adjacent signalized intersections and/or major unsignalized street
II a	Moderate, single phase 500-1000 peak hour trips	1. Opening year 2. 5 years after opening	1. Site access driveways 2. All State highways, signalized intersections, and/or major unsignalized street intersections within a half-mile
II b	Large, single phase, >1000 peak hours	1. Opening year 2. 5 years after opening (b) 3. 10 years after opening	1. Site access driveways 2. All State highways, signalized intersections, and/or major unsignalized street intersections within one mile
II c	Moderate or large, multi-phase	1. Opening year 2. 5 years after opening (b) 3. 15 years after opening	1. Site access driveways 2. All State highways, signalized intersections, and/or major unsignalized street intersections within one mile

Process Overview

- Existing Traffic Volumes (*Turning Movements*)
- Existing Level of Service (*LOS*) for Each Turning Movement
- Expected Trip Generation of Development
- Expected Trip Distribution of Development
- Traffic Assignment for Development
- Future Traffic without the Development
- Future Traffic with the Development
- Signal Needs Assessment
- Future Level of Service *(LOS)* with the Development
- Improvement Plan

Data Collection

- Turning movement counts - AM and PM peak hour for all major study area intersections
- Daily traffic volumes - can be extrapolated a maximum of 2 years if current data is not available
- Accident data - collected for the most current 3-year period
- Roadway and intersection geometrics - roadway width, number of lanes, lane configuration at intersections, channelization
- Traffic control device inventory - signal timing and phasing, stop signs, yield signs, etc.

Analysis Requirements

- Capacity Analysis - Level of service (LOS) for signalized and unsignalized intersections in accordance with latest edition of Highway Capacity Manual (HCM)
- Traffic Signal Needs - Conducted for all intersections for all analysis time periods as per ADOT Traffic Manual
- Queuing Analysis - Conducted for all turn lanes under stop or signal control
- Accident Analysis - Review historic data for any anomalies and/or concerns

Mitigation Thresholds

- Mitigate intersection LOS to level C if no-build LOS is better than C.
- Mitigate intersection LOS to same level with development as without if no-build LOS is worse than C.
- Level of service of D may be acceptable within urban areas of over 50,000 population at discretion of Regional Traffic Engineer.

Reference Materials

- ADOT Traffic Impact Analysis for Proposed Development
- ADOT Traffic Manual
- ADOT Roadway Design Guidelines
- Institute of Transportation Engineers' (ITE) Trip Generation Handbooks
- Transportation Research Board's Highway Capacity Manual (HCM)
- Federal Highway Administration's Manual on Uniform Traffic Control Devices (MUTCD)
- A Policy on Geometric Design of Highways and Streets (AASHTO)

Example

- 250 Single Family Homes
- Buildout of development in 1 year (2005)
- Southeast corner of Central Avenue and Main Street
- Example hits major concepts - *TIA Requires More*
- Example is hypothetical not necessarily reflective of specific engineering design requirements

Determine Analysis Requirements

- # of Trips in Highest Peak Hour

Analysis Category	Development Characteristics (d)	Study Horizons	Minimum Study Area On the State Highway(s)
I	Small Development <500 peak hour trips	1. Opening year	1. Site access driveways 2. Adjacent signalized intersections and/or major unsignalized street intersections
II a	Moderate, single phase 500-1000 peak hour trips	1. Opening Year 2. 5 Years after opening	1. Site access driveways 2. All State highways, signalized intersections, and/or major unsignalized street intersections within ½ mile
II b	Large, single phase, >1000 peak hour trips	1. Opening year 2. 5 years after opening 3. 10 years after opening	1. Site access driveways 2. All State highways, signalized intersections, and/or major unsignalized street intersections within 1 mile

Land Use	Intensity	Units	Daily Total	AM Peak			PM Peak		
				In	Out	Total	In	Out	Total
Single-Family Detached Housing	250	Dwelling Units	2,408	46	138	184	157	88	245
Total			**2,408**	**46**	**138**	**184**	**157**	**88**	**245**

Single-Family Detached Housing (ITE 6th Edition)

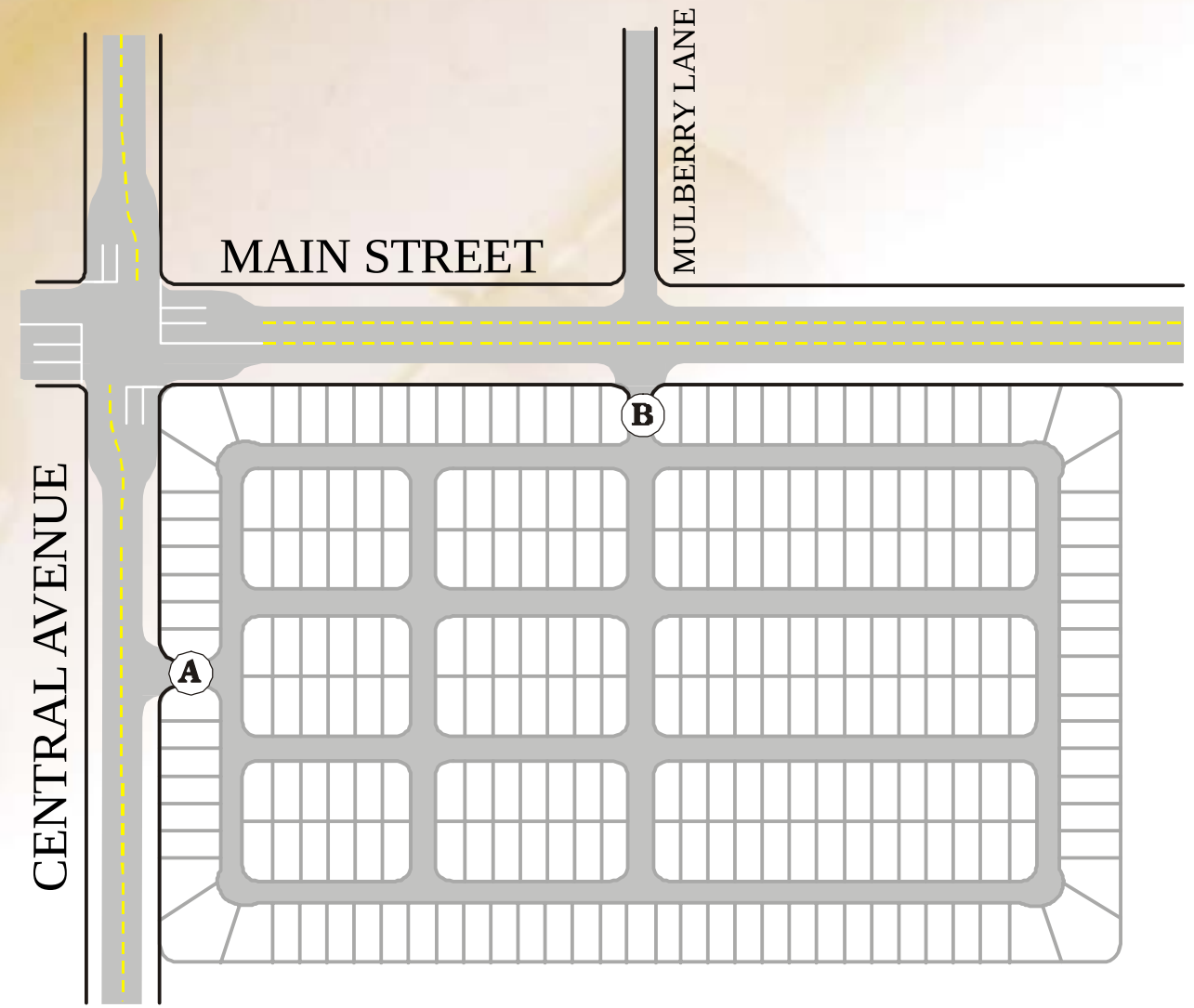
Daily (ITE 210)	**Ln(T)= 0.920 Ln (Dwelling Units) + 2.707**	**50% In**	**50% Out**
AM Peak Hour (ITE 210)	**T=0.700 (Dwelling Units) + 9.477**	**25% In**	**75% Out**
PM Peak Hour (ITE 210)	**Ln(T)= 0.901 Ln (Dwelling Units) + 0.527**	**64% In**	**36% Out**

Data Collection

- Site Plan

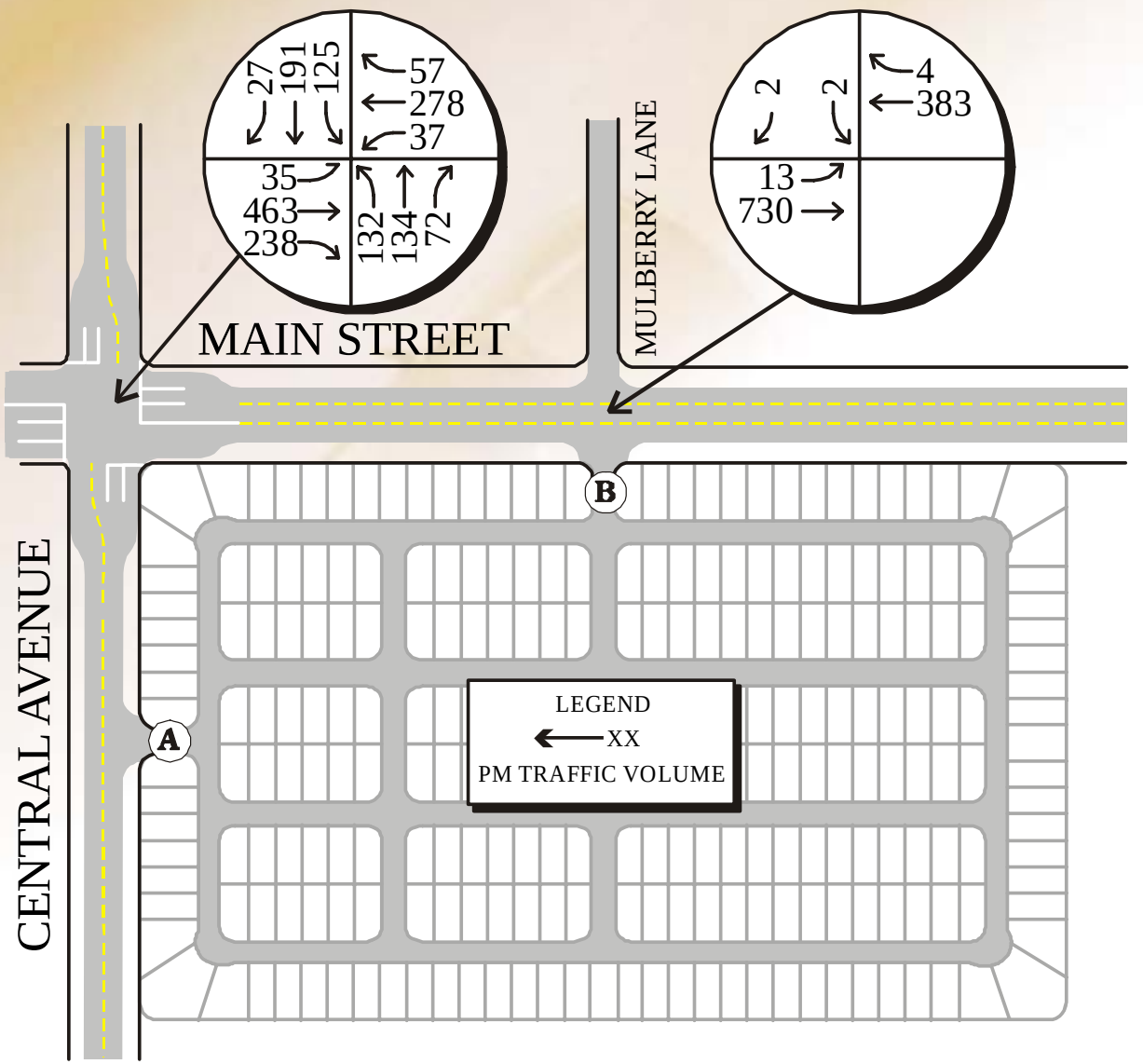
  Existing Volumes

  Existing Conditions



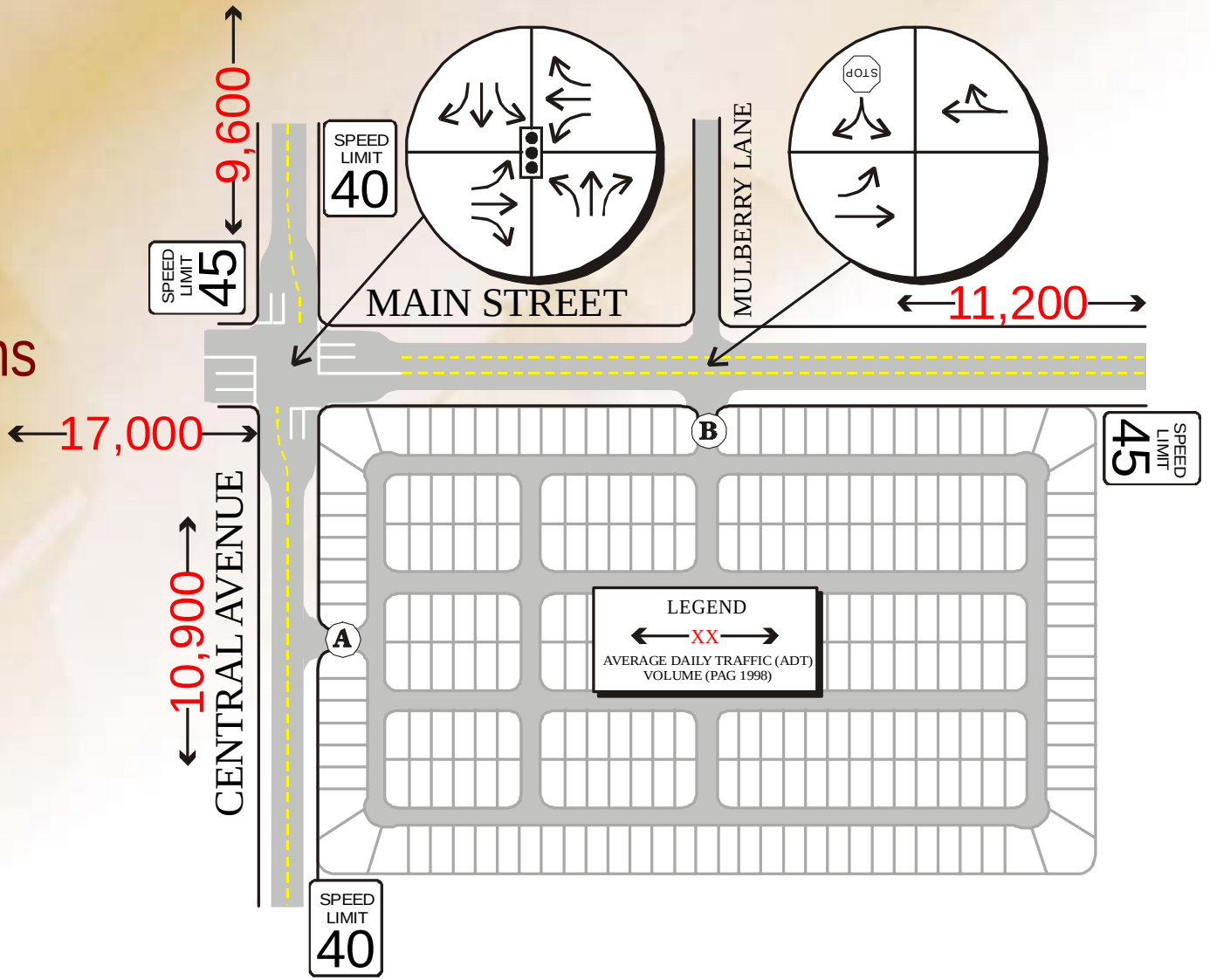
Data Collection

- Site Plan
- Existing Volumes
- Existing Conditions



Data Collection

- Site Plan
- Existing Volumes
- Existing Conditions

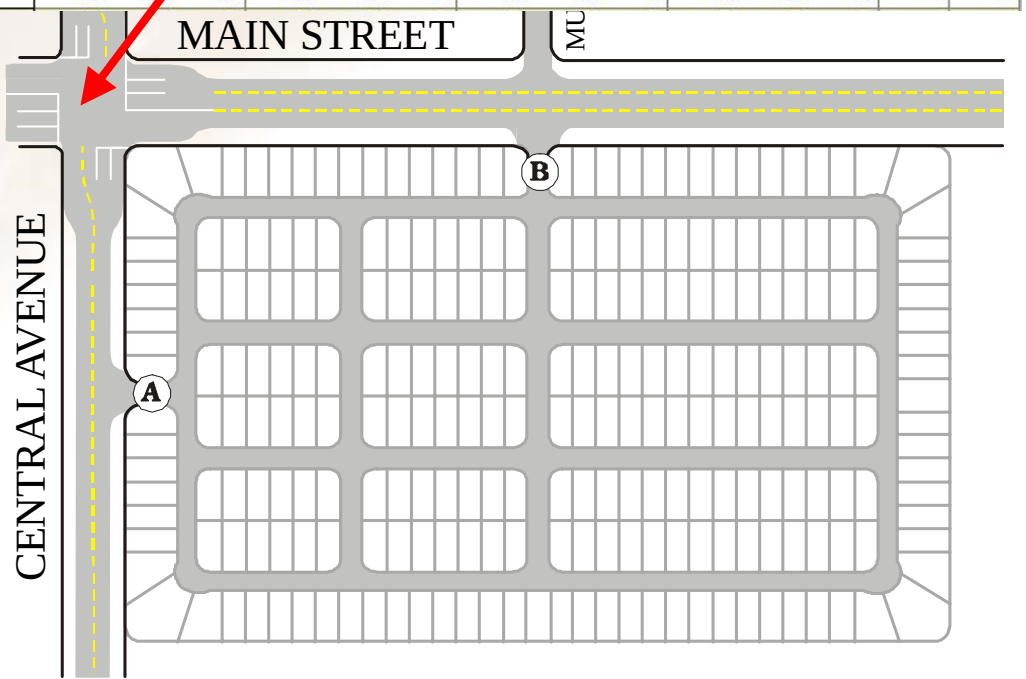


Existing Conditions Analysis

- HCM Analysis

  Queue Length

TIMING WINDOW	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	PED	HOLD
Lanes and Sharing (#RL)													—	—
Traffic Volume (vph)	35	463	238	37	278	57	132	134	72	125	191	27	—	—
Turn Type	Perm	—	Perm	Perm	—	Perm	Perm	—	Perm	Perm	—	Perm	—	—
Protected Phases		4			8			2			6			
Permitted Phases	4		4	8		8	2		2	6		6	—	—
Detector Phases	4	4	4	8	8	8	2	2	2	6	6	6	—	—
Control Delay (s)	6.4	8.0	1.4	6.7	6.9	2.4	12.3	11.1	4.0	11.9	11.3	5.6	—	—
Level of Service	A	A	A	A	A	A	B	B	A	B	B	A	—	—
Approach Delay (s)	—	5.7	—	—	6.2	—	—	10.1	—	—	11.1	—	—	—
Approach LOS	—	A	—	—	A	—	—	B	—	—	B	—	—	—
Queue Length 50th (ft)	3	54	0	3	28	0	18	17	0	17	26	0	—	—
Queue Length 95th (ft)	18	178	27	20	97	14	78	70	0	72	96	0	—	—



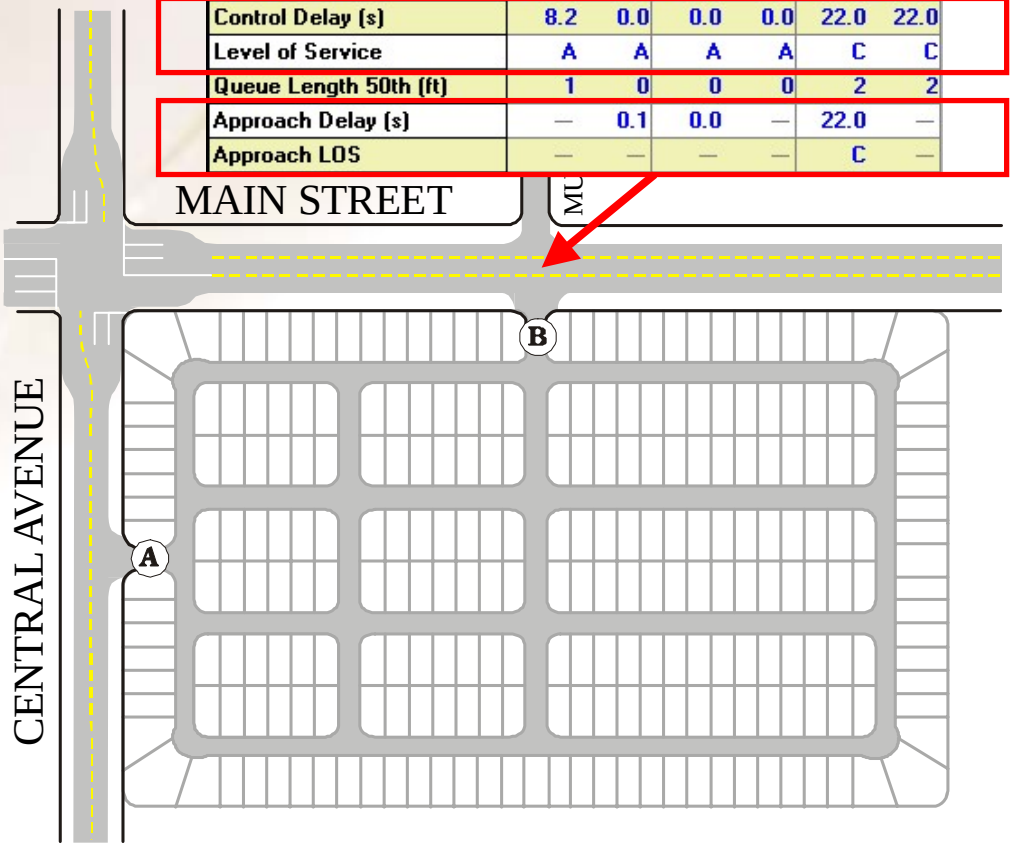
Synchro 5.0 Output

Existing Conditions Analysis

- HCM Analysis

  Queue Length

SIGNING WINDOW	EBL	EBT	WBT	WBR	SBL	SBR
Lanes and Sharing (#RL)						
Traffic Volume (vph)	13	730	383	4	2	2
Sign Control	—	Free	Free	—	Stop	—
Median Type	—	None	None	—	TWLTL	—
Median Width (vehs)	—	—	—	—	0	—
Right Turn Channelized	—	None	—	None	—	None
Volume to Capacity Ratio	0.01	0.47	0.25	0.25	0.02	0.02
Control Delay (s)	8.2	0.0	0.0	0.0	22.0	22.0
Level of Service	A	A	A	A	C	C
Queue Length 50th (ft)	1	0	0	0	2	2
Approach Delay (s)	—	0.1	0.0	—	22.0	—
Approach LOS	—	—	—	—	C	—



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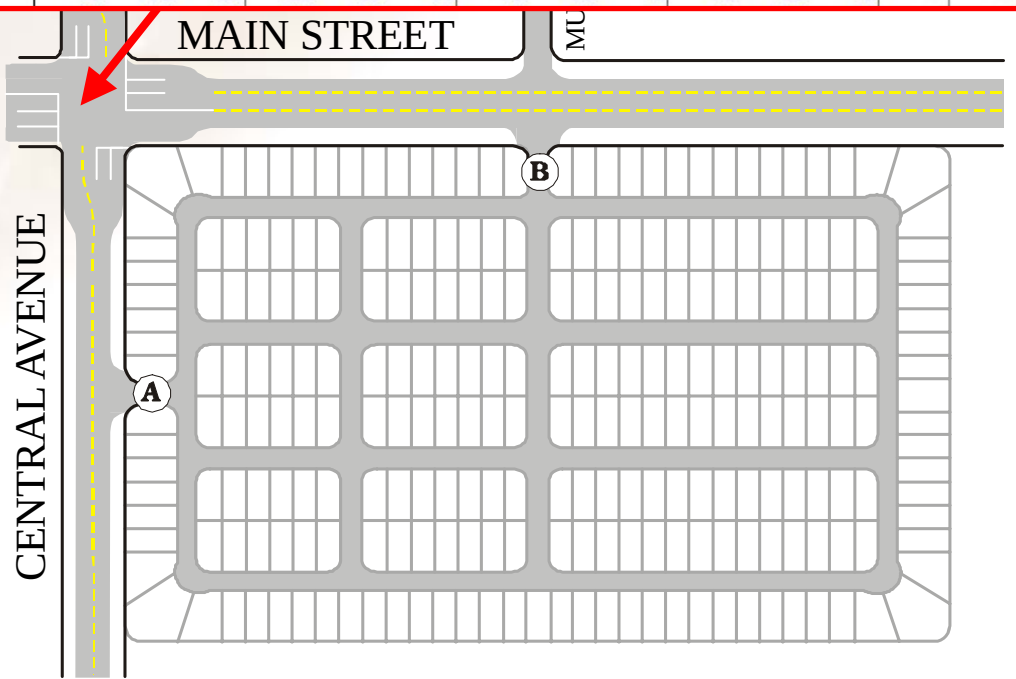
Existing Conditions Analysis

HCM Analysis

- Queue Length

TIMING WINDOW	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	PED	HOLD
Lanes and Sharing (#RL)													—	—
Traffic Volume (vph)	35	463	238	37	278	57	132	134	72	125	191	27	—	—
Turn Type	Perm	—	Perm	Perm	—	Perm	Perm	—	Perm	Perm	—	Perm	—	—
Protected Phases		4			8			2			6			
Permitted Phases	4		4	8		8	2		2	6		6	—	—
Detector Phases	4	4	4	8	8	8	2	2	2	6	6	6	—	—
Control Delay (s)	6.4	8.0	1.4	6.7	6.9	2.4	12.3	11.1	4.0	11.9	11.3	5.6	—	—
Level of Service	A	A	A	A	A	A	B	B	A	B	B	A	—	—
Approach Delay (s)	—	5.7	—	—	6.2	—	—	10.1	—	—	11.1	—	—	—
Approach LOS	—	A	—	—	A	—	—	B	—	—	B	—	—	—
Queue Length 50th (ft)	3	54	0	3	28	0	18	17	0	17	26	0	—	—
Queue Length 95th (ft)	18	176	27	20	97	14	78	70	0	72	96	0	—	—



Synchro 5.0 Output

Existing Conditions Analysis

HCM Analysis

- Queue Length

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Lanes and Sharing (#RL)						
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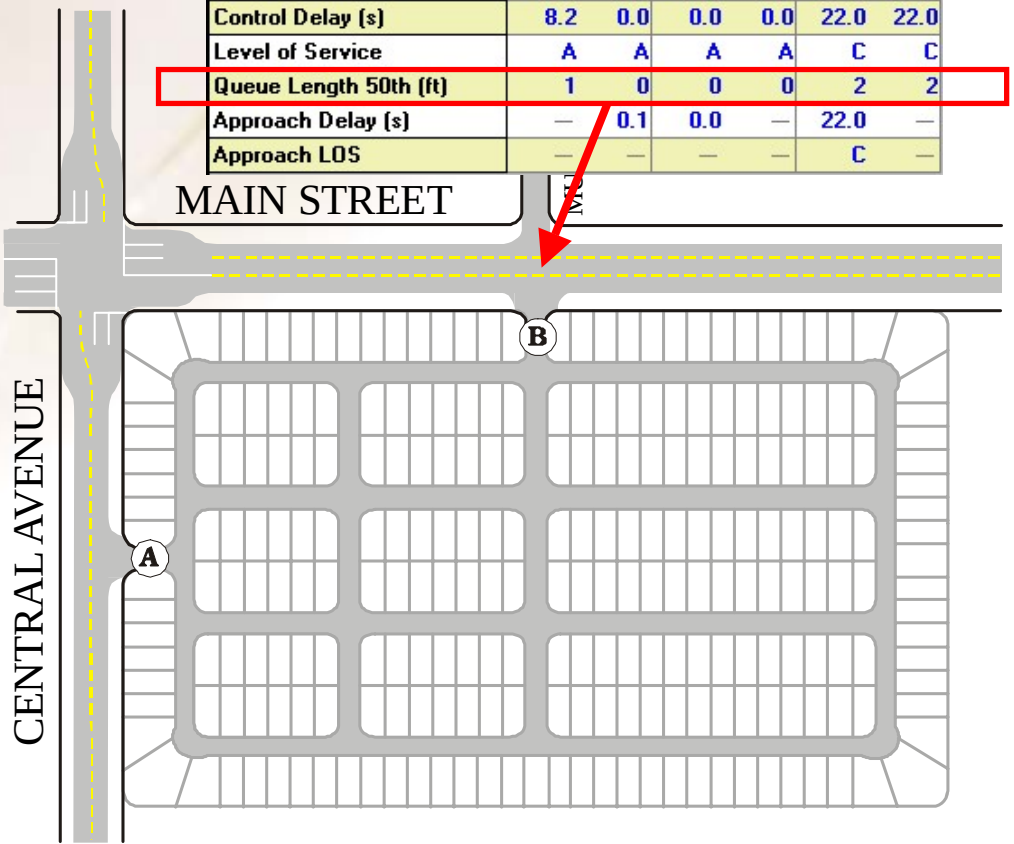
Sign Control	—	Free	Free	—	Stop	—
Median Type	—	None	None	—	TWLTL	—
Median Width (vehs)	—	—	—	—	0	—
Right Turn Channelized	—	None	—	None	—	None
Volume to Capacity Ratio	0.01	0.47	0.25	0.25	0.02	0.02
Control Delay (s)	8.2	0.0	0.0	0.0	22.0	22.0
Level of Service	A	A	A	A	C	C
Queue Length 50th (ft)	1	0	0	0	2	2
Approach Delay (s)	—	0.1	0.0	—	22.0	—
Approach LOS	—	—	—	—	C	—



Synchro 5.0 Output

Site Trip Characteristics

- Trip Generation
- Trip Distribution
- Trip Assignment

Land Use	Intensity	Units	Daily Total	AM Peak			PM Peak		
				In	Out	Total	In	Out	Total
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Site Trip Characteristics

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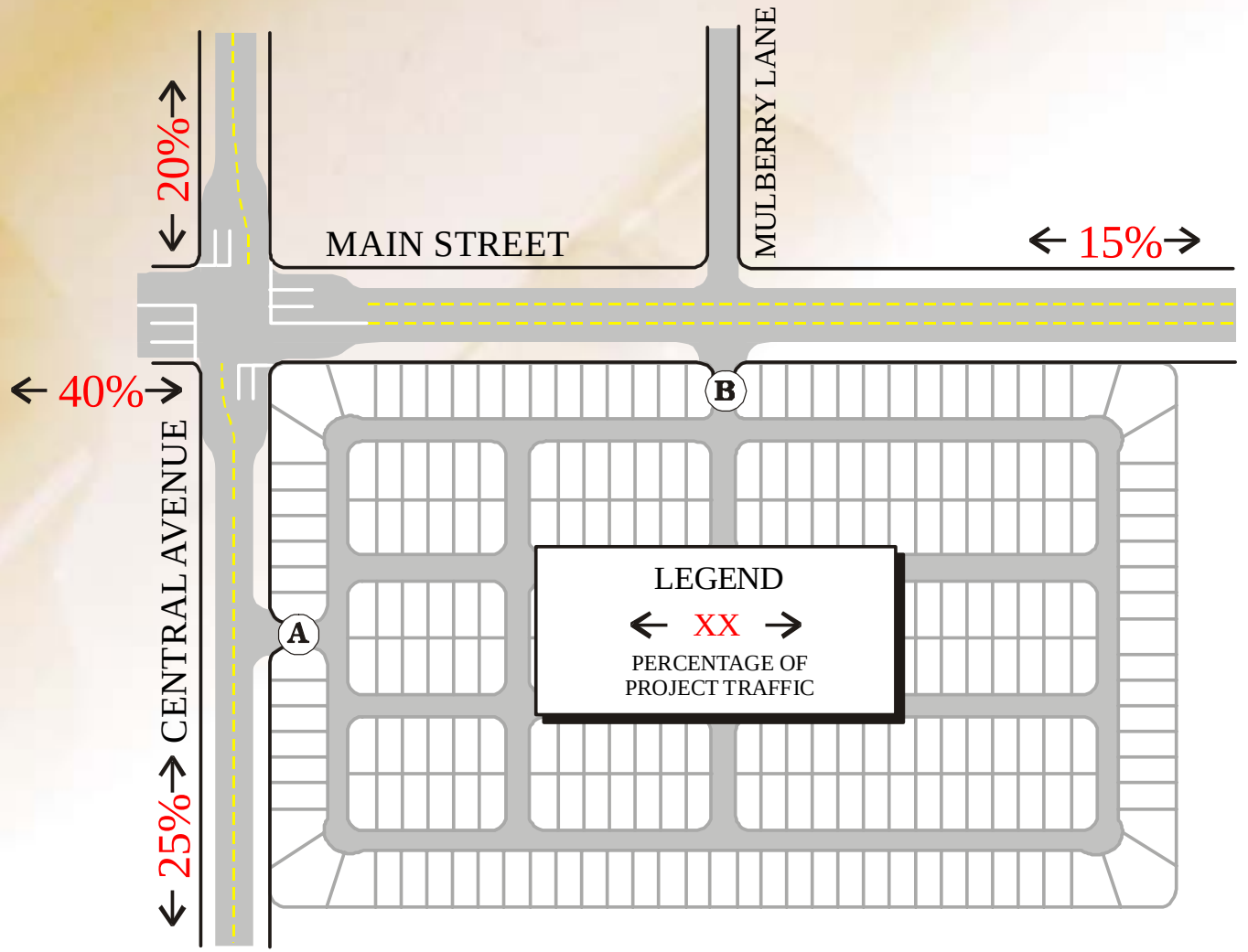
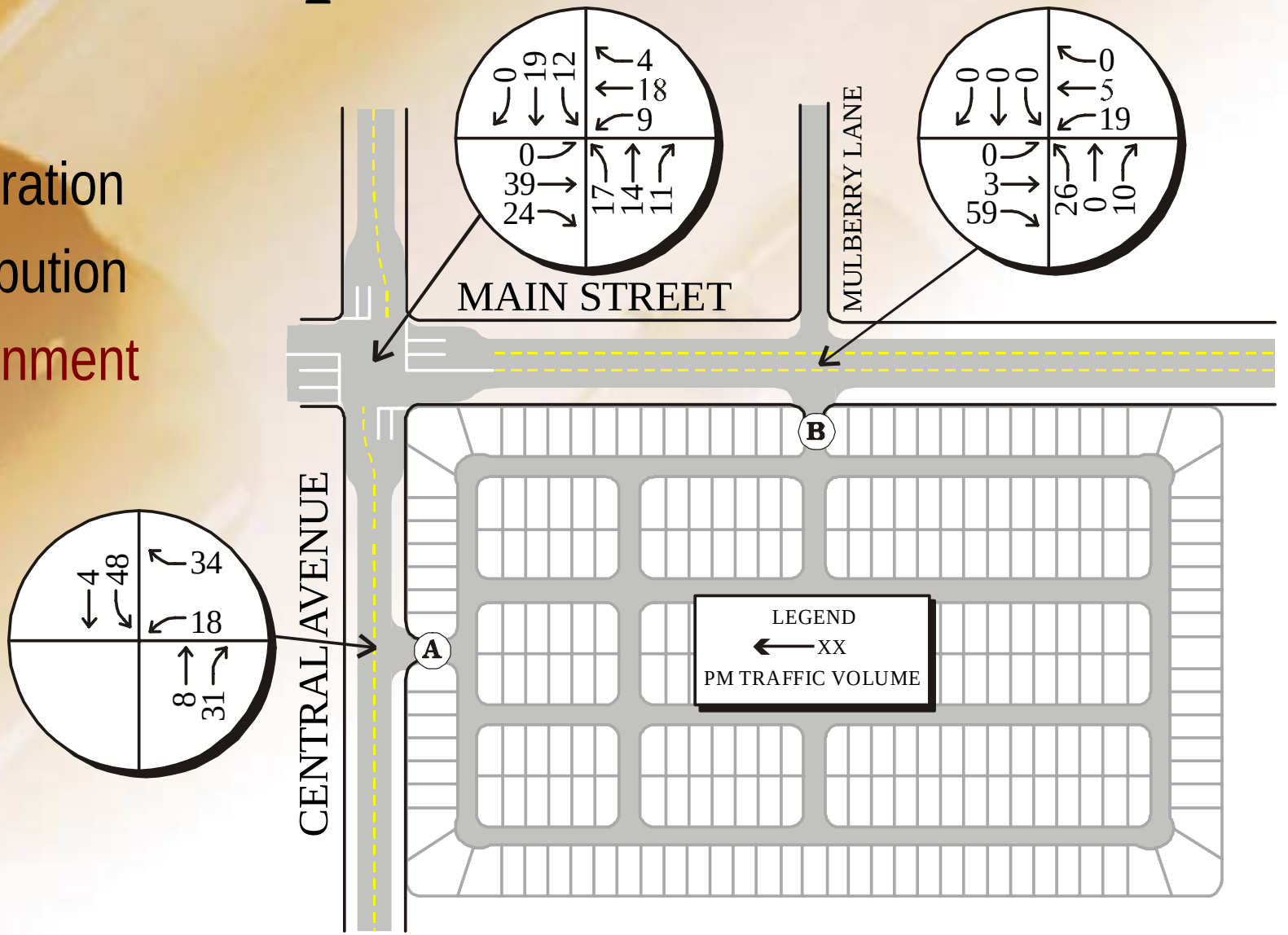
- Trip Assignment



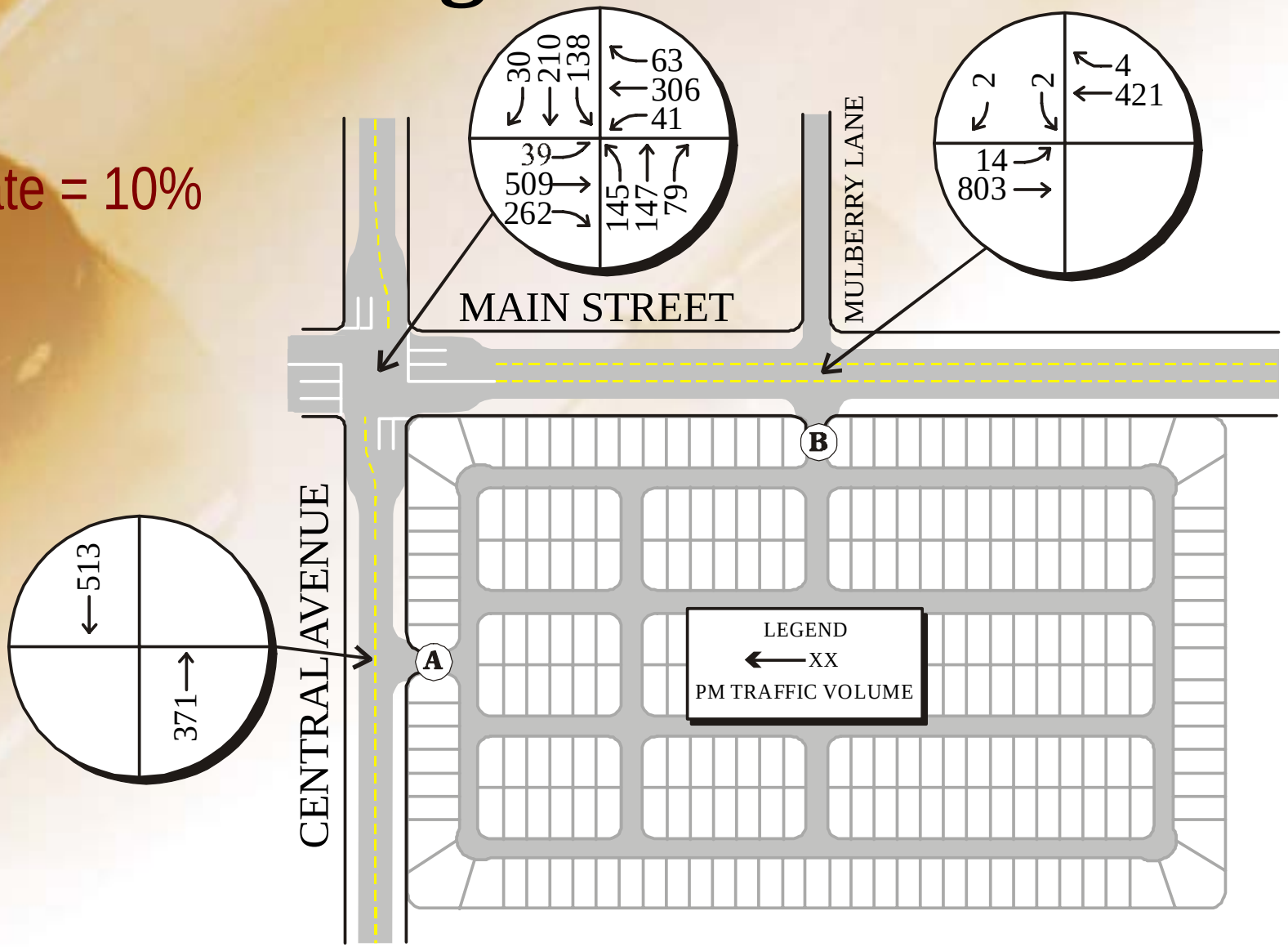
Site Trip Characteristics

- Trip Generation
- Trip Distribution
- Trip Assignment



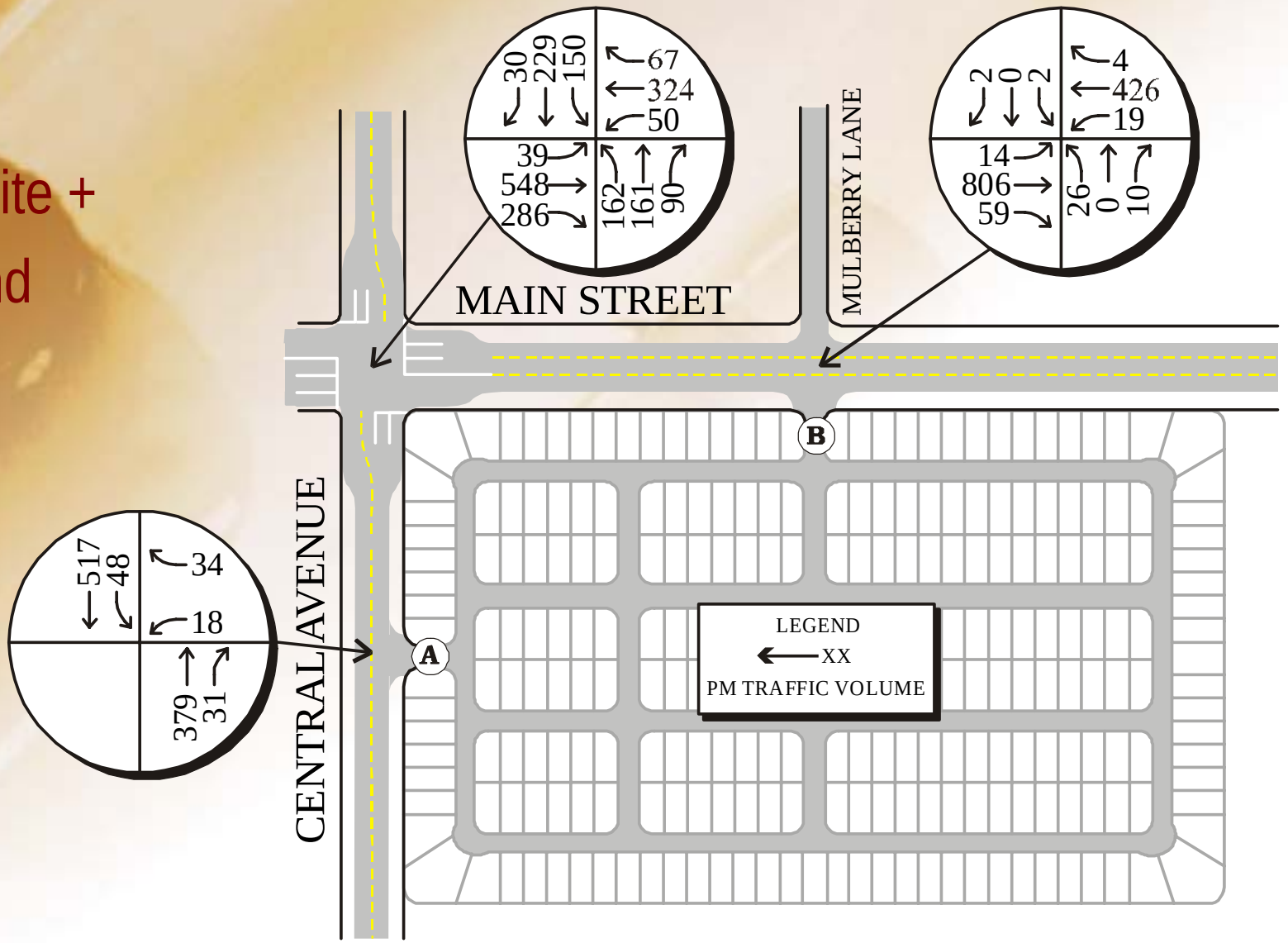
Future Background Traffic

- Growth Rate = 10% for 1 Year



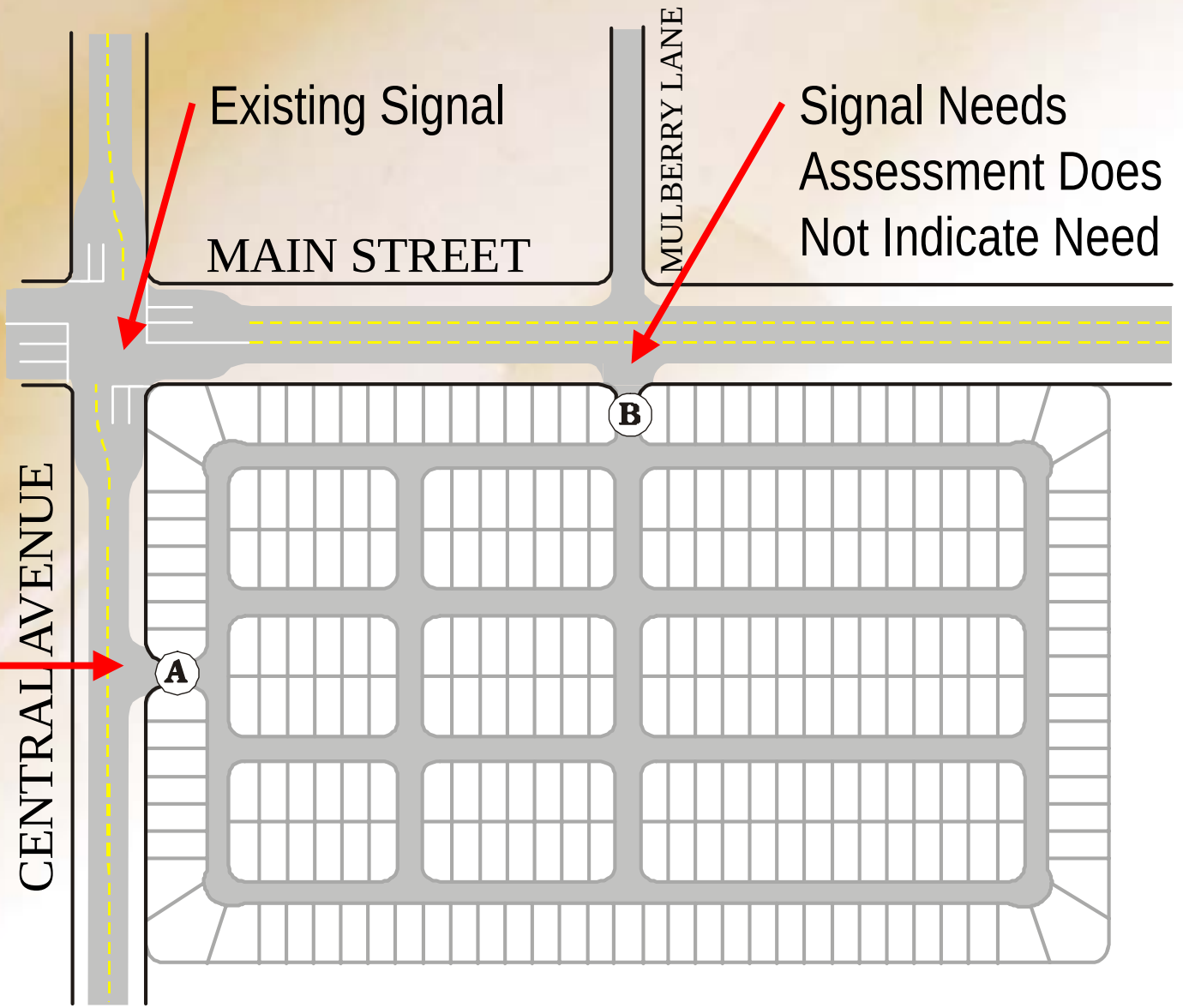
Future Total Traffic

- Future = Site + Background



Future Conditions Analysis

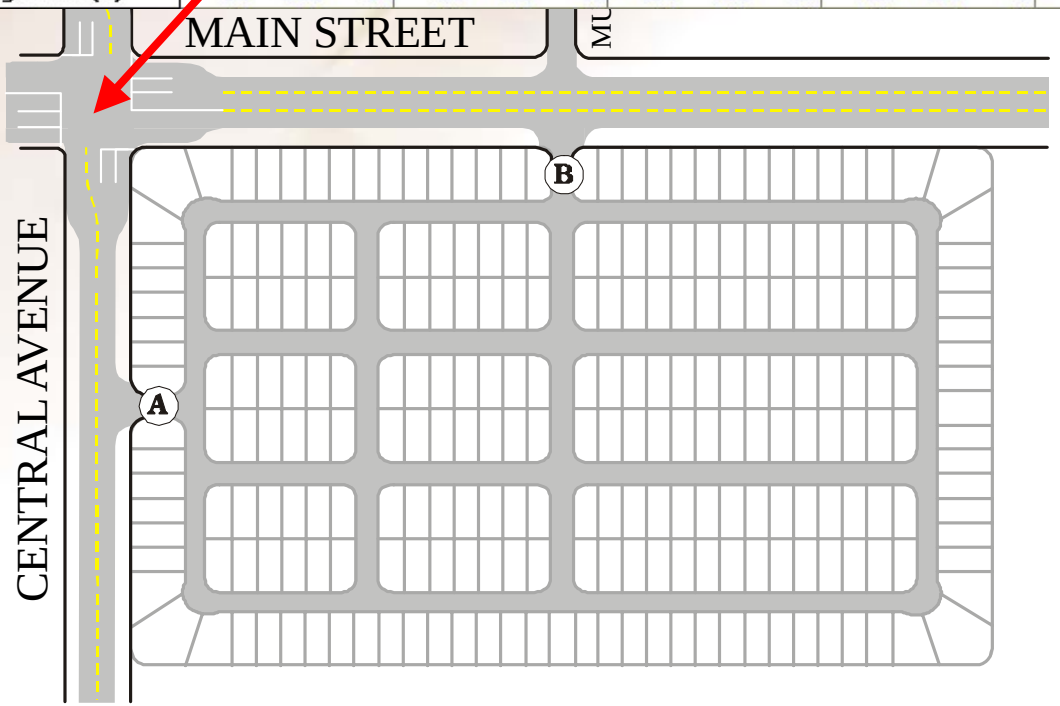
- Signal Need
  - HCM Analysis
  - Queue Length



Future Conditions Analysis

- Signal Need
- HCM Analysis
- Queue Length

TIMING WINDOW	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	PED	HOLD
Lanes and Sharing (#RL)													—	—
Traffic Volume (vph)	39	548	286	50	324	67	162	161	90	150	229	30	—	—
Turn Type	Perm	—	Perm	Perm	—	Perm	Perm	—	Perm	Perm	—	Perm	—	—
Protected Phases		4			8			2			6			
Permitted Phases	4		4	8		8	2		2	6		6	—	—
Detector Phases	4	4	4	8	8	8	2	2	2	6	6	6	—	—
Control Delay (s)	7.9	10.1	1.4	8.7	8.5	2.6	15.4	13.2	4.0	14.5	13.5	6.0	—	—
Level of Service	A	B	A	A	A	A	B	B	A	B	B	A	—	—
Approach Delay (s)	—	7.2	—	—	7.6	—	—	12.0	—	—	13.3	—	—	—
Approach LOS	—	A	—	—	A	—	—	B	—	—	B	—	—	—
Queue Length 50th (ft)	4	85	0	6	42	0	30	27	0	27	40	0	—	—
Queue Length 95th (ft)	25	289	34	34	149	18	125	103	27	108	144	0	—	—



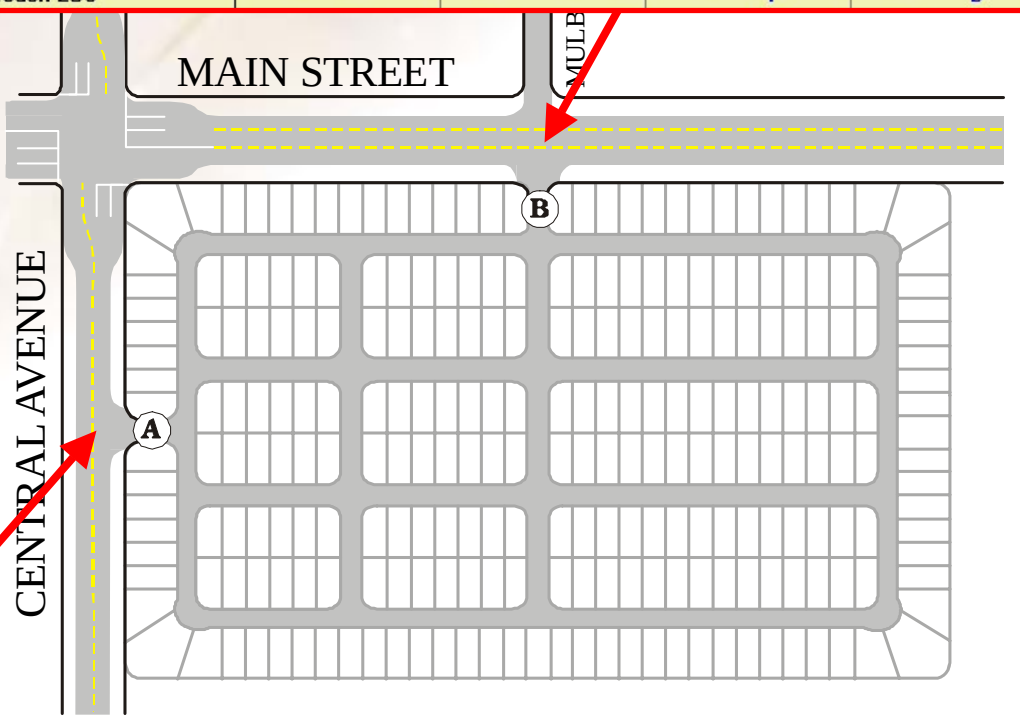
Synchro 5.0 Output

Future Conditions Analysis

- Signal Need
- HCM Analysis
- Queue Length

SIGNING WINDOW	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lanes and Sharing (#RL)												
Traffic Volume (vph)	14	806	59	19	426	4	26	0	10	2	0	2
Sign Control	—	Free	—	—	Free	—	—	Stop	—	—	Stop	—
Median Type	—	None	—	—	None	—	—	⌈WLTL	—	—	⌈WLTL	—
Median Width (vehs)	—	—	—	—	—	—	—	0	—	—	0	—
Right Turn Channelized	—	—	None	—	—	None	—	—	None	—	—	None
Volume to Capacity Ratio	0.01	0.52	0.04	0.03	0.27	0.27	0.40	—	0.40	0.03	—	0.03
Control Delay (s)	8.3	0.0	0.0	10.1	0.0	0.0	65.5	—	65.5	33.9	—	33.9
Level of Service	A	A	A	B	A	A	F	—	F	D	—	D
Queue Length 50th (ft)	1	0	0	2	0	0	41	—	41	3	—	3
Approach Delay (s)	—	0.1	—	—	0.4	—	—	65.5	—	—	33.9	—
Approach LOS	—	—	—	—	—	—	—	F	—	—	D	—

SIGNING WINDOW	WBL	WBR	NBT	NBR	SBL	SBT
Lanes and Sharing (#RL)						
Traffic Volume (vph)	18	34	379	31	48	517
Sign Control	Stop	—	Free	—	—	Free
Median Type	None	—	None	—	—	None
Median Width (vehs)	—	—	—	—	—	—
Right Turn Channelized	—	None	—	None	—	None
Volume to Capacity Ratio	0.14	0.14	0.24	0.02	0.05	0.33
Control Delay (s)	15.6	15.6	0.0	0.0	8.4	0.0
Level of Service	C	C	A	A	A	A
Queue Length 50th (ft)	12	12	0	0	4	0
Approach Delay (s)	15.6	—	0.0	—	—	0.7
Approach LOS	C	—	—	—	—	—

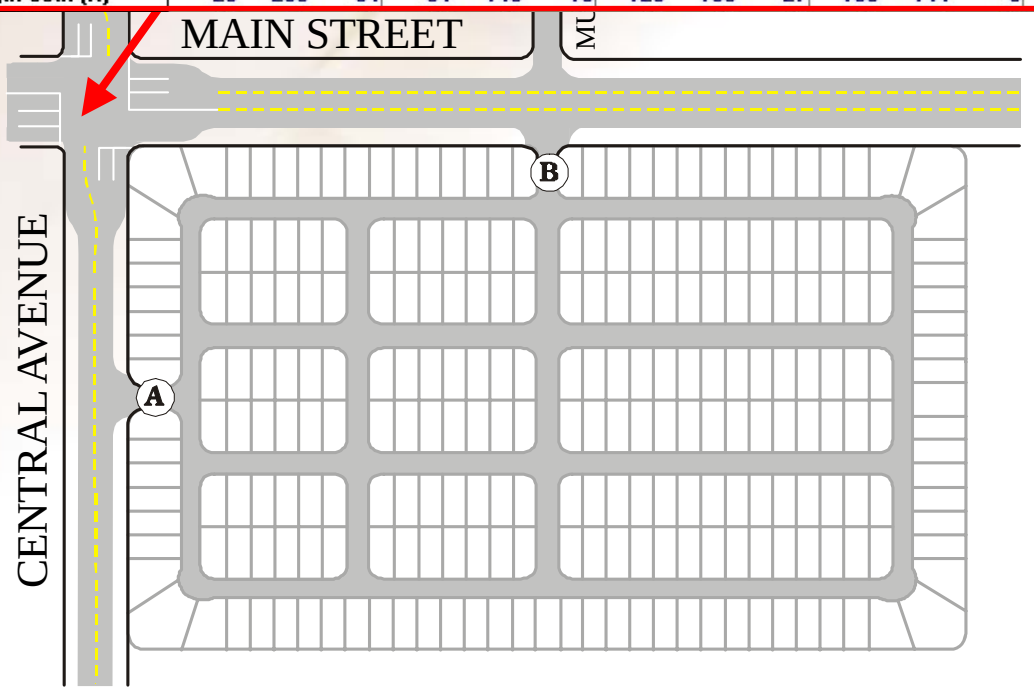


Synchro 5.0 Output

Future Conditions Analysis

- Signal Need
- HCM Analysis
- Queue Length

TIMING WINDOW	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	PED	HOLD
Lanes and Sharing (#RL)													—	—
Traffic Volume (vph)	39	548	286	50	324	67	162	161	90	150	229	30	—	—
Turn Type	Perm	—	Perm	Perm	—	Perm	Perm	—	Perm	Perm	—	Perm	—	—
Protected Phases		4			8			2			6			
Permitted Phases	4		4	8		8	2		2	6		6	—	—
Detector Phases	4	4	4	8	8	8	2	2	2	6	6	6	—	—
Control Delay (s)	7.9	10.1	1.4	8.7	8.5	2.6	15.4	13.2	4.0	14.5	13.5	6.0	—	—
Level of Service	A	B	A	A	A	A	B	B	A	B	B	A	—	—
Approach Delay (s)	—	7.2	—	—	7.6	—	—	12.0	—	—	13.3	—	—	—
Approach LOS	—	A	—	—	A	—	—	B	—	—	B	—	—	—
Queue Length 50th (ft)	4	85	0	6	42	0	30	27	0	27	40	0	—	—
Queue Length 95th (ft)	25	289	34	34	149	18	125	103	27	108	144	0	—	—



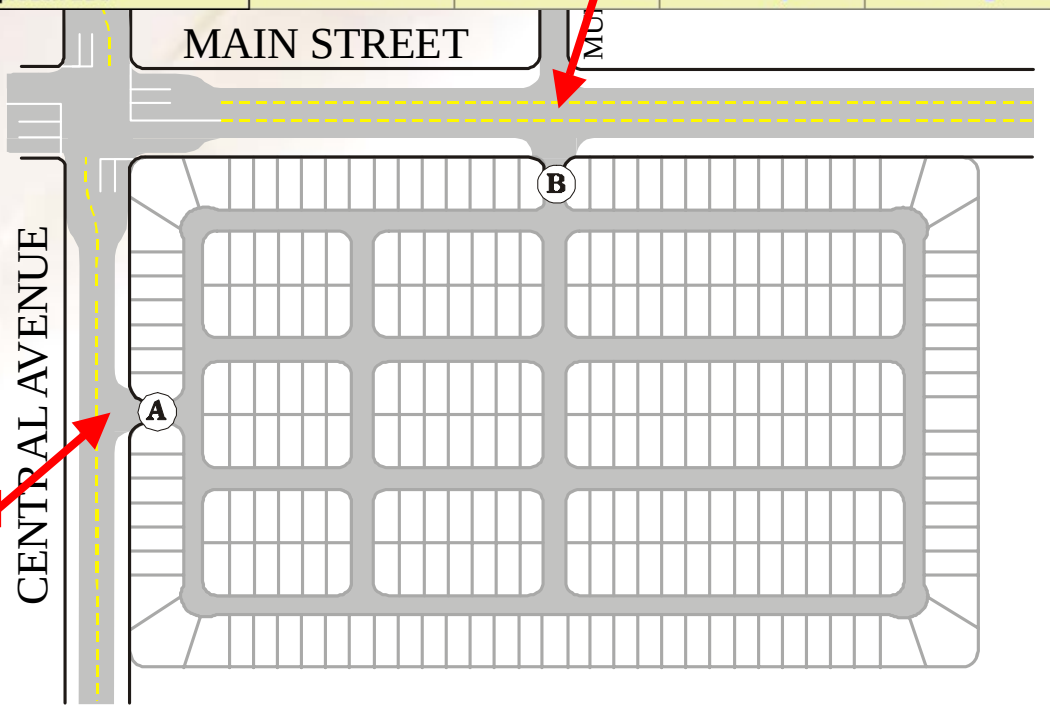
Synchro 5.0 Output

Future Conditions Analysis

- Signal Need
- HCM Analysis
- Queue Length

SIGNING WINDOW	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lanes and Sharing (#RL)												
Traffic Volume (vph)	14	806	59	19	426	4	26	0	10	2	0	2
Sign Control	—	Free	—	—	Free	—	—	Stop	—	—	Stop	—
Median Type	—	None	—	—	None	—	—	⌈WLTL	—	—	⌈WLTL	—
Median Width (vehs)	—	—	—	—	—	—	—	0	—	—	0	—
Right Turn Channelized	—	—	None	—	—	None	—	—	None	—	—	None
Volume to Capacity Ratio	0.01	0.52	0.04	0.03	0.27	0.27	0.40	—	0.40	0.03	—	0.03
Control Delay (s)	8.3	0.0	0.0	10.1	0.0	0.0	65.5	—	65.5	33.9	—	33.9
Level of Service	A	A	A	B	A	A	F	—	F	D	—	D
Queue Length 50th (ft)	1	0	0	2	0	0	41	—	41	3	—	3
Approach Delay (s)	—	0.1	—	—	0.4	—	—	65.5	—	—	33.9	—
Approach LOS	—	—	—	—	—	—	—	F	—	—	D	—

SIGNING WINDOW	WBL	WBR	NBT	NBR	SBL	SBT
Lanes and Sharing (#RL)						
Traffic Volume (vph)	18	34	379	31	48	517
Sign Control	Stop	—	Free	—	—	Free
Median Type	None	—	None	—	—	None
Median Width (vehs)	—	—	—	—	—	—
Right Turn Channelized	—	None	—	None	—	None
Volume to Capacity Ratio	0.14	0.14	0.24	0.02	0.05	0.33
Control Delay (s)	15.6	15.6	0.0	0.0	8.4	0.0
Level of Service	C	C	A	A	A	A
Queue Length 50th (ft)	12	12	0	0	4	0
Approach Delay (s)	15.6	—	0.0	—	—	0.7
Approach LOS	C	—	—	—	—	—

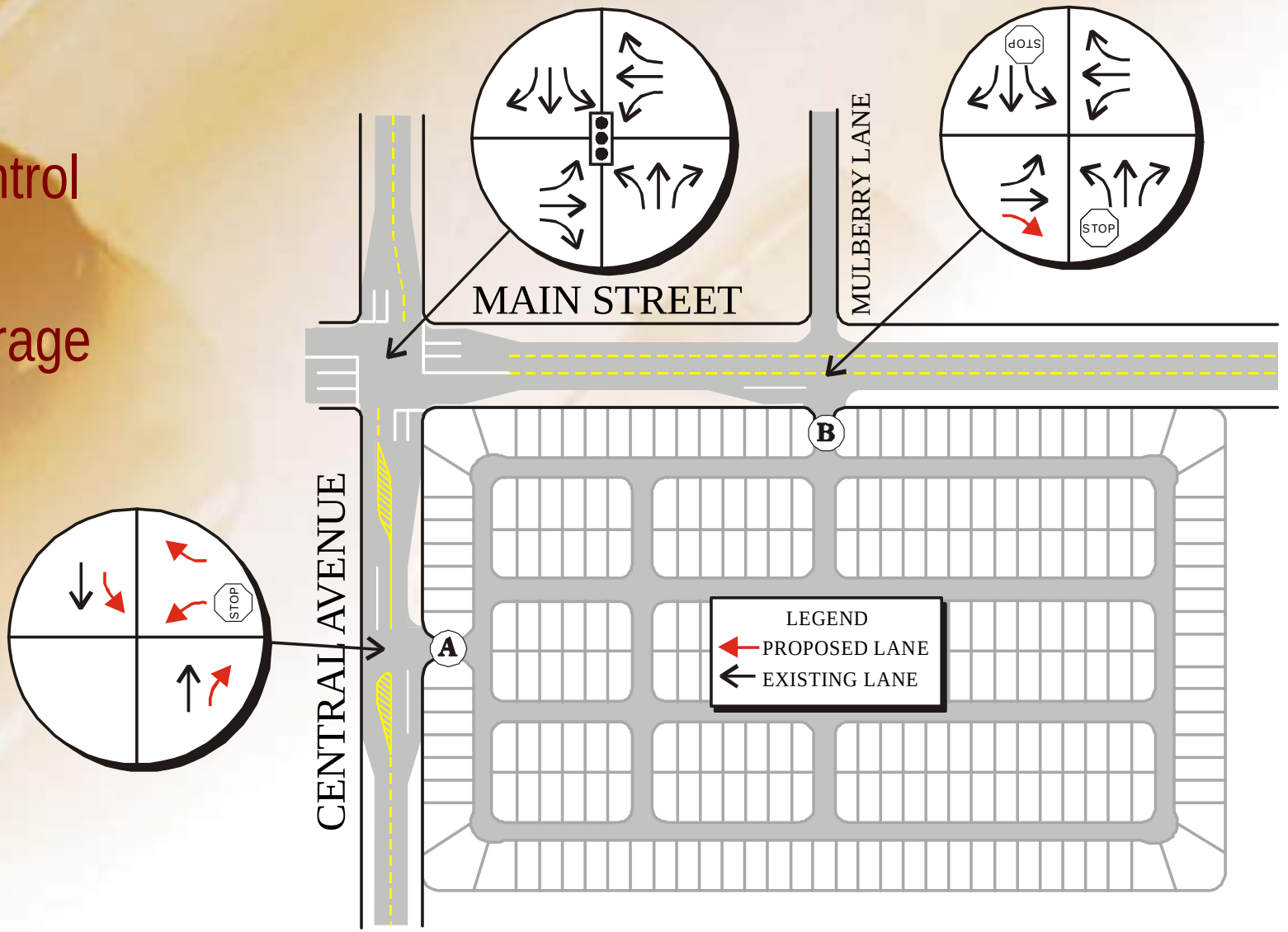


Synchro 5.0 Output

Recommended Improvements

- Traffic Control
- Additional Lanes/Storage

Other



Recommended Improvements

- Traffic Control
- Additional Lanes/Storage
- Other
- Sight Distance
- Access Control
- Driveway Corner Clearance
- Circulation
- Etc….